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HAZARDOUS WASTE SITE INSPECTION REPORT
Litton Industries - Advanced Circuitry Division
Springfield, Missouri

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P&P

I. EXECUTIVE SUMMARY

The Site Inspection was performed on the former irrigation area at the Litton Facility. This area was initially for disposal of the waste rinsewater generated at the electroplating facility to eliminate the discharge off of the property. The flow of wastewater had previously been entering a sinkhole to the northwest of the plant.

As the facility expanded and the amount of wastewater increased, the two acre terraced irrigation field became inadequate for disposing of all of the water. A lagoon was constructed to provide storage and reduce flow by loss of water through evaporation and percolation. The plant also made some internal changes to reduce the amount of water generated.

The irrigation area, as well as the lagoon, were designed upon the ion exchange capacity of the clay soils. The intent was to reduce the metal content of the wastewater by land applying it and allowing the soils to trap the metal ions. The water would then filter on through or be taken up in the root systems of the plants. The problem with the system appeared to be the large volume of water generated by the facility because periodic discharges of wastewater occurred.

The samples taken of the water which was generated at the rate of 150,000 -200,000 gallons per day but later reduced to 34,000 gallons per day showed the levels of metals to be as high as 13 ppm copper, 2 ppm lead, 1.2 ppm chromium, 0.75 zinc, and 0.75 for cadmium. Some of these levels were reduced with the installation of control equipment in the plant.

The irrigation site was used from 1971 to 1982 at which time the connection was made to the municipal sewerage system. At that time the lagoons were eliminated and the sludge from them was hauled to a hazardous waste disposal facility. This was done with overview by the Department of Natural Resources.

In 1981, following a complaint by a disgruntled Litton employee that the plant was dumping industrial solvents into their lagoon, samples of the lagoon were taken which indicated levels of volatile organics exceeding 100 ug/l. Because of these high levels and the fact that the lagoon lies in an area of karst topography, there was considerable concern about the quality of the groundwater in the area northeast of the site. Included in this concern was the spring which flowed through the cave at Fantastic Caverns.

In June, 1981, 14 private wells and springs were sampled in the area and tested for volatile organics. Volatile organics were detected in each of the springs and in one of the private wells, however, the amount in the private well was less than what was considered a safe level. The conclusion of the report was that any dumping of solvents which had taken place had apparently had little immediate effect on the quality of the groundwater in the area.

Because of the other industries in the northern area of Springfield and the complexities of the karst topography of the area, it is difficult to determine the effects of any one site on the groundwater in north central Greene County. Area wells have been determined to be shallow cased and many are old wells that are less than the recommended depth. Those wells that are deep may be serving as conduits for contaminants because of improper construction or inadequate casing.

Additional dye traces are planned for the sinkholes in the area. An extremely dry summer hampered the implementation of these studies at any earlier date. It is not known for certain whether the north sinkhole on the Litton site is in the recharge area for Ritter Spring West which is located about 2.8 miles to the northeast or in the recharge area for the northern springs which are about 3.2 miles from the site. Any wells in the area between the site and the springs could potentially be contaminated if migration of contaminants offsite is occurring. Private well sampling has not demonstrated the offsite migration of contaminants but the spring sediment sample at Ritter Spring West shows higher than background chromium and copper levels and the water from the spring contained Trichloroethylene which was found in high concentrations at the Litton Site. As was stated in a report in the files, however, Litton is not the only industry in northern Springfield that has used Trichloroethylene as a solvent.

II. BACKGROUND

A. Location of Site

The site is located at 4811 West Kearney Street in Springfield, Missouri, about 3 3/4 miles west of the intersection of Kearney and Kansas Streets. The legal description of the site is SE 1/4, SW 1/4, Sec 6, T. 29 N., R. 22 W., Brookline Quadrangle, Greene County. (Ref 1 & 2).

B. Site Layout

The facility sets north of Kearney Street and east of the Springfield Municipal Airport. The area which was used for land application of the rinse water lies north and northeast of the parking lot which is on the north side of the building. The land application area was somewhat barren of vegetation at the time of the sampling. Even though the sampling was performed in January there was little evidence that the soils supported plant growth except in some of the upper areas near the parking lot.

C. Site Ownership History

Litton Industries purchased the site as three different parcels. The first parcel was purchased from the Industrial Development Corporation in 1963 after it had been leased first. The second parcel was purchased from the city of Springfield and the third parcel was purchased from Mr. and Mrs. Roscoe Prescott in 1964.

D. Site Use History

The first building was built on the site by Litton Industries in 1967-68. Until that time the property was either agricultural or vacant land. Several additions have been built since the initial building was constructed.

E. Permit and Regulatory History

In 1972 Litton received an Operating Permit from the Clean Water Commission for the operation of the waste water lagoon. In 1974 an NPDES Permit was issued but was terminated in 1975 when the discharge was thought to have been eliminated. In 1975 Litton received a Letter of Approval for the construction and subsequently the operation of a no discharge system which included land application of the waste water. A Consent Order was issued in September, 1980, which called for the company to cease the discharge of rinsewater from their property.

F. Remedial Actions to Date

No action has been taken by the company or the Department recently in regards to the leach field. The original purpose of the irrigation system was to provide an ion exchange system for the rinse water pumped from the lagoon in an effort to reduce the metal ion content of the water and to eliminate the discharge of wastewater from the facility.

In 1982 the lagoon was eliminated as was the irrigation system when the company began discharging their waste water to the municipal sewerage system. The solid material from the lagoon was removed and disposed of at a hazardous waste facility and the lagoon was dozed in and leveled. Two monitoring wells were to be kept in place to be sampled periodically for obtaining information on the migration of contaminants from the lagoon site, however one of the wells was destroyed during the process of filling the lagoon and the other dried up.

There was at one time a sludge pit and an acid pit on the site. These were both cleaned up in the late 70's with overview of the project performed by Waste Management personnel from Jefferson City and Water Pollution Control personnel from the Springfield Regional Office. After the sludge was removed from the pits the soil below them was sampled to demonstrate that all contaminants had been removed.

G. Summary Trip Report

In preparation for the sampling a visit was made to the area to contact area residents for the purpose of gathering well information and obtaining permission to sample the private wells. Company officials at Litton were also notified of the upcoming sampling.

On January 27, 1988, samples were collected from the leach fields on the Litton property and from area wells and springs. Information regarding the site use and ownership was obtained at a later date.

III. ENVIRONMENTAL SETTING

A. Topography

The Litton Industries Site is located in a relatively gently sloping area surrounded pretty much on all sides by sinkholes. The areas to the north northwest, east, and south contain sinks that exceed forty acres in size with some having a relief of more than fifty feet. (Ref 4).

Runoff from the site flows to the north then west to a sink on the Springfield Municipal Airport property. Sinks in the area have been shown to recharge Ritter Spring, Williams Spring and Fantastic Cavern Spring. (Ref. 6).

The average slope of the Litton Site is estimated to be 2-3% with the slope in the irrigation area to the north. The area east of the irrigation site is where the lagoon was located before it was eliminated in 19 (Ref 6 & 8).

The headwaters area of Spring Branch which discharges into the Little Sac River is located about one mile from the site to the east. Though no surface water from the site would reach these headwaters, there may be some groundwater connection. The headwater area of the Clear Creek Basin is located within one mile of the site to the west. Again there is no surface water connection due to the sinkholes surrounding the site. (Ref 6 & 8).

B. Surface Waters

Except for a small area due west of the site, the surface water flow is restricted to wet weather flows into sinkholes with most flow appearing to travel less than one mile before entering the eye of a sinkhole. The area to the west recharges Clear Creek and a portion of the area northeast of the site, about 1 1/2 miles away, enters Spring Branch. For the most part, all of the surface water within 1 1/2 miles of the site enters a sinkhole if it does not enter groundwater through a losing stream before getting there. Surface water is discussed further on page 6 of the Geologist's Report for the site. (Ref 6 & 8).

C. Soils

The Geologist report indicates the soils at the site to be of the Pembroke-Eldon-Creldon association. These are described in detail in the report which included an excerpt from the Soil Survey of Greene and Lawrence Counties, Missouri; USDA, SCS, 1982, but will be summarized here briefly.

The upland soil developed as a residuum from the weathering of the underlying cherty limestone. The soluble carbonate portion of the limestone was altered to residual soil and the more resistant chert was left floating in the soil. This accounts for the chert in the clay and the cherty layers in the soil. The mantles can be expected to range from red colored clay to layers of chert gravel and boulders.

The Pembroke, Eldon, and Creldon soils all appear to be formed by the weathering of cherty limestone. The Soil Survey indicates that the the subsoil beneath these soils is typically red to reddish brown cherty silty clay. This appears to be what was observed on the surface of the irrigation field which was noted to be, for the most part, void of vegetation. The geologist noted that the soils at the site are very permeable as is the bedrock. This would be expected in areas of karst topography as found at the site. (Ref 6)

D. Groundwater

The groundwater at the site is somewhat what one would expect in a karst setting however it is also complex with springs functioning differently depending on the weather conditions. The geohydrologic information from the DGLS report follows.

"The Litton site is within a 4 - 5 square mile internally drained area northwest of the Springfield City limits (See map included as reference 3). Within this sinkhole plain, all precipitation enters the groundwater system in one way or another. Much of the precipitation enters sinkholes, which funnel water like a storm-sewer system to spring outlets to the north and east. A significant amount of precipitation percolates through the permeable residual soil to the top of the pinnacled bedrock. These laterally discontinuous perched water zones provide base flow to the area springs by slowly releasing the groundwater to solution-enlarged conduits. A minor amount of the precipitation that falls on the area, possibly an insignificant amount, bypasses the karst drainage system and recharges the regional Mississippian Aquifer below the vadose zone."

"When heavy and/or prolonged precipitation occurs at the Litton site, surface flow drains predominantly to a sinkhole in the northeast corner of the Springfield Municipal Airport. An artificial drainage channel has been constructed along the eastern side of the airport, which empties into the broad, shallow "Airport Sink". This was done to prevent ponding of water around the northeast runway. The southeast part of the Litton site is drained by a sinkhole on the other side of the company's east property line. Fluorescein dye was injected into the Airport Sink after a heavy rain and the dye was recovered at the Williams, Fantastic Caverns, and Bunge Springs to the north-northeast (see reference 3 of the Geologist's report). During low flow conditions, these springs function independently of each other, as shown by the results of other dye injections during dry weather, but in high flow, they appear to overflow and co-mingle with each other."

"Properly cased water wells downgradient of the site should be unaffected by the contaminants originating there. Even poorly cased wells (those that are open to at least part of the vadose zone) are marginally susceptible to being contaminated from the Litton site because the chances of intercepting a solution-enlarged conduit are relatively small. Wells completed in the Ordovican aquifer and cased below the Northview confining unit are in no danger of being contaminated from the Litton Site."

The Geologist goes on in his report to describe the two aquifers of concern.
"There are two aquifers of concern here. The upper aquifer is composed of all bedrock units above the Northview aquitard, predominantly limestone and cherty limestone. This aquifer is highly susceptible to contamination due to its proximity to the surface and the high degree of solution weathering it has been subjected to. The yield from this aquifer is highly variable (1-50 gpm), depending on depth of penetration of the aquifer and the amount of secondary permeability features intercepted by the wellbore. The lower, or major aquifer, is separated from the upper aquifer by the 25-30' thick Northview Formation, which is mainly shale with minor siltstone. This thick aquifer is composed of dolomite and sandstone, and is recharged almost entirely from the precipitation falling on its outcrop area to the east of the Salem Plateau. A minor amount of recharge from the overlying upper aquifer does occur because of the head differential between the two aquifers. Wells open to the entire sequence are capable of producing 1000-2000 gpm. The major aquifer is not susceptible to contamination from local sources unless poorly cased water wells are present that provide an avenue of contaminant transport. (Reference 1)."

Additional dye tracing studies are planned for the future in the area. The Geologist's report includes a map showing the connection between the sinkholes near the site and the springs to the northeast of the site. (Ref 6).

E. Climate and Meteorology

Meteorological Data for this region is as follows:

Temperatures -

Average summer	76 degrees F
Average winter	36 degrees F
Low record	-29 degrees F
High record	113 degrees F

County which adjoin Springfield. Besides the fact that the airport and industrial park are closeby, the northwest part of town has been slower to develop and the outlying areas are still made up mostly of farms with pastureland or rural residences with large tracts of undeveloped land. Much of the area is plagued with sinkholes and is undesirable for the development of residential subdivisions.

The estimated population within three miles of the site is 16,000. This was derived at by estimating the number of rural residences and multiplying by 3.8 then adding this number to an estimate of the number of people living inside the city limits of Springfield and within the three mile radius. The latter number was obtained by figuring the average density per square mile of the city of Springfield and multiplying this number by the number of square miles of city within three miles of the site.

H. Water Supply

Water in the immediate area of the site is provided by a public water supply, i.e. the City of Springfield. The outlying areas to the north, northeast, and west primarily are served by private water wells or small non-community systems. There are also several private water supply wells serving residences and businesses within one mile of the site.

A survey of several wells in the area shows a range in depth of 75 feet to 400 feet. The casing depth in these wells varies from 21 feet to 110 feet but the casing depth on most of the wells was not known by the property owners surveyed. (Ref. 9)

I. Critical Environments

Mr. Dan F. Dickniete, Environmental Administrator for the Missouri Department of Conservation, indicates the Royal catchfly (Silene regia) occurs within 1.0 mile of the site. This plant is watchlisted in Missouri and is a federal candidate for listing as a threatened or endangered species. The record is from 1984. The Black-tailed jackrabbit occurs within 1.0 miles of the site. This animal is rare in Missouri. The record is from 1987.

There is also some concern for the well being of the blind cave fish which is found in the Fantastic Caverns stream. Dye studies have shown a direct link between the airport sink and Fantastic Caverns as well as with Williams and Bunge Springs to the north-northeast.

IV. WASTE TYPES AND QUANTITIES

The Department of Natural Resources files indicate that Litton began irrigating rinsewater from the plating operations onto the channelized irrigation field in August, 1971. The wastewater first flowed through the lagoon system and what did not percolate or leak out was irrigated. The initial wastewater flow was estimated at 150.000 to 200,000 gpd. After an ion exchange and recirculation system was installed the volume was reduced to about 40,000 gpd.

Analysis on this water showed the levels of metal to range from .35 mg/l on Cadmium to 13 mg/l for copper. Lead values were detected at up to 2.0 and chromium up to 1.2 mg/l.

This water was irrigated onto the 2 acre site from August, 1971 to mid 1982 at which time the company connected the wastewater discharge to the municipal sewerage system which had recently become available.

Samples collected by MDNR Lab Services Personnel in January, 1988, contained metals levels well above background levels detected in the area. A summary sheet for the sample results is attached. The results showed the soil in the upper leach field to contain total chromium at 390 ug/l, total lead at 290 ug/l, and total copper at 4500 ug/l. Nickel, cadmium, barium and silver were detected at levels above background but did not appear as significant as the others listed above. Arsenic was detected at a level of 33 ug/l, about ten times the background level.

The sample from the lower leach field had above background levels for chromium, copper, and lead as well as for barium, nickel, and arsenic but the levels were not as significant as those in the soil from the upper leach field.

1,1,1-Trichloroethane was found in concentrations exceeding 1 mg/l in the soils of the upper leach field and Trichloroethylene was found in concentrations exceeding .2 mg/l in the soil samples from both the upper and the lower leach fields. Trichloroethylene was also found in a private well and in Ritter Spring, however a direct connection between the site and these two water sources has not yet been confirmed.

At the present time there are no known hazardous wastes stored at the site which are not regulated under RCRA. The amount of soil which is contaminated with metals has not been determined but it could be a large part of the 2 acres which were used for the land application of the waste water.

V. LABORATORY DATA

A copy of the Laboratory Services Report on Investigation is attached as is a summary sheet of the sample results for the soils and nearby wells and springs. The results indicate elevated levels of copper, chromium, arsenic and lead in some of the samples. Copper, nickel, and solder (lead) were noted to have been used by the company in their plating operations and the chromium is also often present in plating waste apparently from a variety of proprietary chemicals used in plating operations.

The chlorinated solvents detected in the samples were probably from the adhesive removal operation or the board preparation operation prior to the plating.

VI. TOXICOLOGICAL DATA/CHEMICAL CHARACTERISTICS

The toxicological data will be provided for the metals and solvents detected in the irrigation field at levels felt to be substantially above background levels. 1,2-Dichloroethylene and carbon disulfide were found in two of the wells sampled but there is no reason to believe these chemicals originated from the Litton Site.

Copper - Although copper is not a hazardous waste itself, it has been shown to have adverse effects on health and the environmental. Certain copper compounds can be irritants to the skin and upper respiratory tract while others, when ingested, can cause vomiting, gastric pains, dizziness, exhaustion, anemia, cramps, convulsions, shock, coma, and death. Damage to the kidneys and the nervous system have also been recorded due to the ingestion of copper. The recommended maximum level for copper listed in the Public Drinking Water Regulations is 1 mg/l.

The toxicity of copper compounds varies greatly from toxic effects detected at 120 ug/kg for the ingestion of the copper metal and an LD50 of 470 mg/kg for copper oxide to lethal doses of some copper compounds as low as 10 mg/kg. It appears that the main consideration in determining the toxicity of copper compounds is the toxicity of the other constituents of the compound rather than the copper itself.

Chromium - Chromium compounds have been shown to be have adverse effects on the skin. The characteristic lesion is a deep, penetrating ulcer which is slow to heal. Little information was available on the effects of ingestion of the compounds on humans however the Public Drinking Water Regulation lists the maximum contaminant level for chromium at 0.05 mg/l. Volume 3 of Drinking Water and Health states that concentrations of 50 ug per gram of diet have been associated with growth depression and liver and kidney damage in laboratory animals but symptoms of excess dietary intake of chromium in humans are unknown. Rats have tolerated the ingestion of 25 ppm of hexavalent chromium for a year with no apparent effects however larger doses are said to be highly toxic and may cause death.

Lead -

The EPA standard for lead in drinking water is 50 ug/l. The Registry of Toxic Effects of Chemical Substances list the following:

orl-wmn TDLo:450 mg/kg/6yr
orl-pgn LDLo:160 mg/kg

The Dangerous Properties of Industrial Materials book states that lead is believed to be a carcinogen of the kidneys and lungs however the Drinking Water and Health, volume four, states that there is no evidence that lead is carcinogenic or teratogenic in humans and that there is not sufficient information available from which to calculate a SNARL. It does indicated that lead can induce biochemical and functional disorders with adverse effects on reproduction.

1,1,1-Trichloroethane -

LD50 oral-rat: 10,3000 mg/kg
inh-man TCLo: 350 ppm TFX:PSY
ivn-dog LDLo: 95 mg/kg

SNARLs are listed as 490 mg/l for 24 hour exposure and 70 mg/l for 7 day exposure.

Trichloroethylene -

orl-hmn LDLo:7 gm/kg
LD50 orl-rat: 4920 mg/kg

One day and ten day SNARLS are listed as 3 mg/l and 0.3 mg/l respectively.

Information on toxicity was obtained from the Registry of Toxic Effects of Chemical Substances and from Dangerous Properties of Industrial Materials. SNARLs information came from Office of Drinking Water, US EPA.

VII. SUMMARY AND RECOMMENDATIONS

The study showed elevated levels of lead, copper, chromium, and two solvents used in plating operations to be present in the upper leach field. These were also shown to be present in the lower leach field but were in lesser concentrations. Arsenic, silver and nickel were also present in the soil samples at above background levels.

Groundwater samples also showed the presence of solvents with one well having Methylene chloride and another containing Trichloroethylene. The well containing the Trichloroethylene has been resampled but the analytical results were not yet available at the time of this writing.

It appears that the leach field may have been effective in capturing the copper ions as it was designed to do. It apparently also concentrated the other metal as they were higher in the upper leach field than in the lower. The question that remains is whether or not the metals and solvents have migrated from the leach fields into the groundwater system and if they have, how widespread is the contamination. It would most likely require the installation of groundwater monitoring wells and a more extensive sampling of wells and springs in the area along with further dye studies to complete the evaluation of the site.

Information obtained late in the course of the investigation indicates that there was an acid pit and a sludge pit at the facility. The acid pit was located at the upper end of the irrigation field and the sludge pit was north of it. Water Pollution Control Personnel in the Springfield Regional Office indicate that the sludge was removed from both of the pits and properly disposed of with overview of the project by Waste Management personnel from Jefferson City. After the sludge was removed the soils were sampled to demonstrate adequate cleanup so these units should pose no health or environmental problems.

Without monitoring wells or some other method of determining migration that may be ongoing, it is difficult to determine whether or not removal of the contaminated soil would be beneficial in preventing further migration of contaminants into the groundwater system.

The study showed the presence of metal and solvent contamination at the site but it is difficult to evaluate the potential threat the site may be on health and the environment.

REFERENCES AND ATTACHMENTS

1. EPA Form 2070-13(7-81) Site Inspection Report Form

2. Preliminary Assessment Report

3. Greene County Highway Map

4. USGS Topography Maps composed of corners of 4 quads

5. Site Layout Map

6. DNR - DGLS Geologic Report

7. MDNR Laboratory Services Report of Sampling Analysis

8. MDNR Files

9. Well Information Survey

10. Drinking Water and Health, 1977

11. Dangerous Properties of Industrial Materials, Fifth Edition, 1979

12. Registry of Toxic Effects, 1979

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